

# Audio classification of Urbansound8k dataset using machine learning and deep learning



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**Abstract:** In each part of human existence, sound assumes a significant part. From individual security to basic observation, sound is a vital component to foster the mechanized frameworks for these fields, Sound recognizable proof is considered as serious deal in sound analysis and sound classification field, so in this project we have utilized machine learning models and deep learning algorithms, for example, DNN for the ID of various sounds from various voices datasets with the assistance of Different classifier to which class it has a place as indicated by classes, for our work and analysis we have taken urbansound8k dataset which contains 8732 named passages which contains 10 unique labelled classes the voice of siren, children playing, street music, dog bark, car horn, air conditioner, drilling, jackhammer, gunshot and engine idling. ANN outperformed all the other machine learning models and decision tree outperformed other models in particularly ML models.

**Keywords:** sound identification, voice classification, audio analysis, ML, DL, urbansound8k dataset.

**Introduction:** The classification of ecological sound has loads of applications in enormous scope and content based mixed media ordering and recovery. These days, in view of mixed media sensor organizations and enormous amounts of online sight and sound substance, individuals focus harder on sound classification in metropolitan conditions.

There are different situations and fields, for example, wellbeing administrations and correspondence where a precise metropolitan sound acknowledgment framework can help individuals [1].

Living in a world encompassed by various types of sound from various sources, our cerebrum and hear-able framework is continually recognizing each sound that it hears, in its direction [1]. Grouping audio or sound has been a significant field of examination for a long time now and there have been many attempted and tried techniques with various models and features which have demonstrated to be helpful and exact. Classification of audio can go from fields like media, bioacoustics checking, and gatecrasher identification in untamed life regions to audio observation, and ecological sounds [2].

In the utilization of artificial insight and progressed sound advancements in creature sound classification, certain difficulties are as yet confronted, for example, the disturbances of foundation commotion [3].

Man-made consciousness innovations are progressively being applied to issues in natural exploration and protection. In the field of untamed life nature, the utilization of man-made consciousness in blend with late advances in review procedures has empowered scientists to gather data on

species events at a lot more extensive spatial and worldly scales than were beforehand conceivable [4].

As of late, deep neural organizations (DNNs) and all the more specifically Convolution neural organizations (CNNs) have been utilized to consequently gain highlight repre-sentations from complex data [5].

Sound acknowledgment issue Comprises of three distinct stages as pre- processing of signals, Extraction of explicit features and their classification. Signal Pre-processing separates the info sign to various fragments This utilized for extracting related features. Include extraction Diminishes the size of data and represent the mind boggling data as Include vectors [6].

Sounds contain rich information and assist with peopling sense the environments around them. Individuals can recognize complex sounds and filter out the meaningful information. Along these lines, noise is dropped and the useful information is refined. Today, sensors can Undoubtedly gather tons of useful audio data ; in any case, processing them to get meaningful information remains burdensome. Many analysts desire to design a human-like machine to reduce this kind of issues [7].

Thus, the fundamental objective of our project is to:

1. Extracting audio features from urbansound8k dataset.
2. Classifying the category of sound based on class with numeric identifier as shown in table 1.

In this project, by utilizing UrbanSound8K dataset, we prepared models including ANN (Artificial neural networks), DT (decision tree), RF (random forest) and SVM (simple vector machine to order sounds in metropolitan conditions.

There are three distinct stages that are connected to the

Classification of sound; pre-processing of the sound sign,

Explicit otherworldly element extraction, lastly the classification of the sound sign. Signal pre-processing samples the input sound sign into different pieces which are used for removing fundamental features.

### Dataset:

Urban Sound 8k [8] dataset is used in this work.

We have done EDA, analysis and applied ML models using urban sound dataset which contains 8732 samples.

Urban sound dataset uses 10 different classes with different labels, Each audio document has a name formatted as [fsID]-[classID]- [occurrenceID]-[sliceID].wav, where fsID is the Free sound ID of the recording from where this extract (slice) is taken, classID is a numeric identifier of the sound class, occurrenceID is a numeric identifier to distinguish unique. Events of the sound inside the original recording, sliceID is a numeric identifier to distinguish various cuts taken from the same event.

### Methodology

**Software:** We have used python 3 with Jupiter notebook to implement the audio classification code.

**Features:** We have used Librosa library to extract the MFCC features which used two types of signals one is mono and other one is stereo we have used mono type for audio analysis in this given dataset and the length of features is 40 used in our project.

**Models and input:** We have used four different models; three machine learning and one ANN model to train and test our data, following is the short description of used models in our work in Table 2.

Table 1

Category (numeric identifier)	Class
0	Air conditioner
1	Car horn
2	Children playing
3	Dog bark
4	drilling
5	Engine idling
6	Gunshot
7	jackhammer
8	siren
9	Street music

Table 2

Model name	Input
ANN	We can foster a solitary MLP neural network model that can make both regression and classification forecasts for a solitary input. This is known as a multi-yield model and can be created utilizing the Keras API.
DT	A decision tree is a graphical portrayal of all potential answers for a decision in light of specific circumstances. On each progression or node of a decision tree, utilized for classification analysis purpose.
RF	A random forest utilized to take care of regression and classification issues. It uses group learning, which is a method that joins numerous classifiers to give answers for complex issues.
SVM	The upsides of support vector machines are: Effective in high layered spaces. Still powerful in situations where number of aspects is more noteworthy than the quantity of samples.

Table 3

RF Classification Report					DT Classification Report					ANN Classification Report					SVM Classification Report				
class	precision	recall	f1-score	support	class	precision	recall	f1-score	support	class	precision	recall	f1-score	support	class	precision	recall	f1-score	support
0	1.00	0.85	0.92	195	0	0.73	0.84	0.78	195	0	0.64	0.92	0.75	195	0	0.48	0.59	0.53	195
1	1.00	0.53	0.69	91	1	0.76	0.62	0.68	91	1	1.00	0.69	0.82	91	1	1.00	0.53	0.69	91
2	0.94	0.41	0.57	205	2	0.58	0.58	0.58	205	2	0.56	0.73	0.63	205	2	0.52	0.62	0.56	205
3	0.97	0.55	0.71	182	3	0.66	0.61	0.63	182	3	0.75	0.73	0.74	182	3	0.63	0.64	0.64	182
4	0.97	0.74	0.84	202	4	0.76	0.74	0.75	202	4	0.90	0.77	0.83	202	4	0.67	0.55	0.60	202
5	0.99	0.87	0.93	216	5	0.83	0.86	0.84	216	5	0.92	0.81	0.86	216	5	0.79	0.59	0.68	216
6	1.00	0.59	0.74	87	6	0.62	0.64	0.63	87	6	0.92	0.53	0.67	87	6	0.83	0.23	0.36	87
7	0.96	0.81	0.88	187	7	0.74	0.73	0.73	187	7	0.87	0.90	0.88	187	7	0.55	0.83	0.66	187
8	1.00	0.74	0.85	199	8	0.80	0.75	0.77	199	8	0.98	0.81	0.89	199	8	0.82	0.78	0.80	199
9	0.91	0.27	0.42	183	9	0.50	0.52	0.51	183	9	0.61	0.61	0.61	183	9	0.45	0.51	0.48	183

## Results and Discussion:

This section discusses the results evaluated during the experiments of used ML models and an ANN model. Metrics we have used in our work are accuracy, classification report and confusion matrix.

**Testing Accuracies:** ANN (model shown in fig 5). gave 75.8% accuracy, decision tree gave 70.2% accuracy and Radom Forest gave 64.68% accuracy and SVM gave 61% accuracy.

**Classification Report:** Precision, f1-socre, recall and support of each ML models and ANN model are shown in table 3.

**Confusion Matrix:** Confusion Matrix of Decision Tree, Random Forest, ANN and SVM are given in Fig1, Fig2, fig3 and fig 4 respectively.

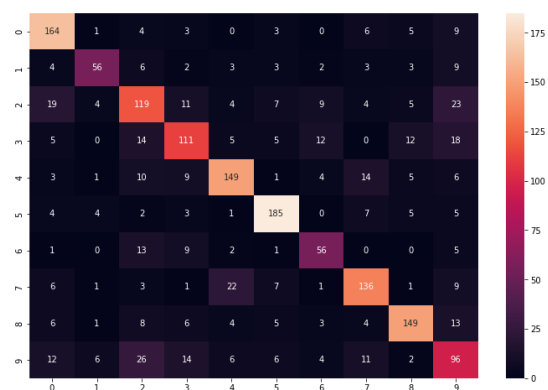


Figure 1: Decision Tree Confusion Matrix

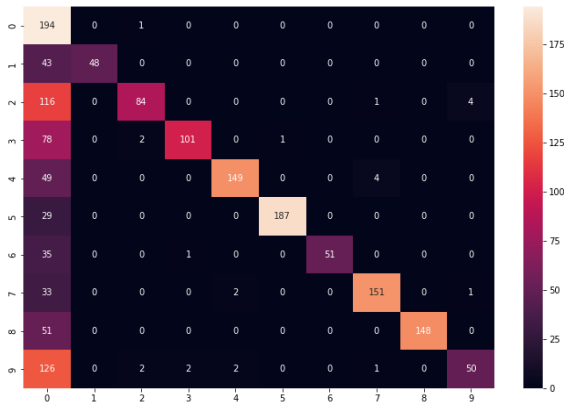


Figure 2: Random Forest Confusion Matrix

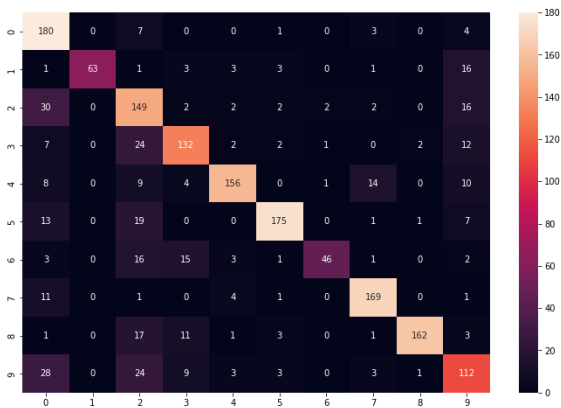


Figure 3: ANN Confusion Matrix

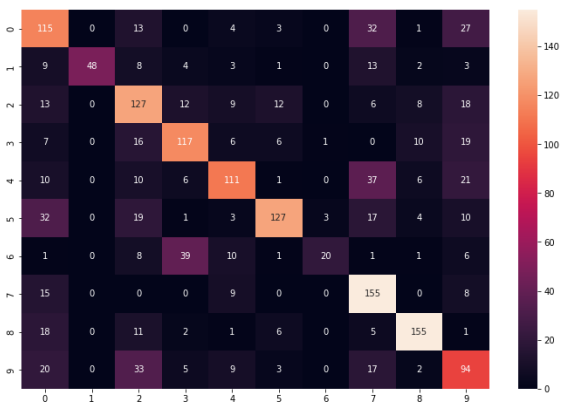


Figure 4: SVM confusion Matrix

From the above discussed results table, one can see that our outcomes are justifiable. This is on the grounds that we did numerous analysis and experiments for extricating appropriate features and tracking down suitable methods. For each component, we attempt to get their actual implications and pick a suitable one for various utilizing purposes. For each neural network, we investigated it completely. From the above outcome table, we can see that our results are very extraordinary.

This is on the grounds that we did numerous analysis and experiments for removing appropriate features and tracking down suitable methods.

For each component, we attempt to get their actual implications and pick a suitable one for various utilizing purposes. For each neural network, we investigated it completely.

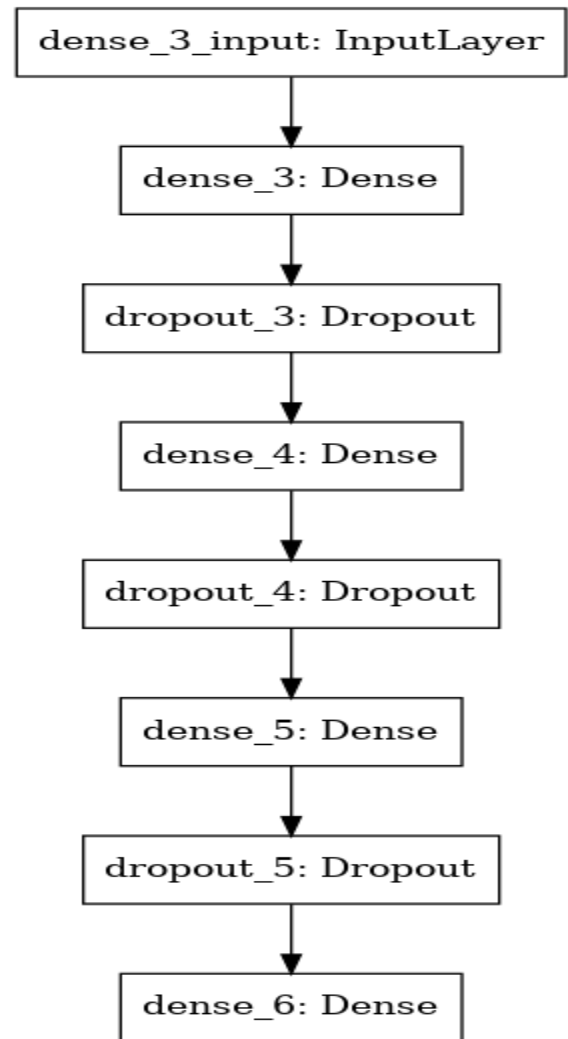


Figure 5: ANN model block diagram

## Conclusion:

We have made project on sound order, exploratory information examination we done by utilizing urbansound8k dataset which utilized 10 unique classes of sound to recognize the class of sound by utilizing numeric identifier esteem, In this task, we have executed different AI techniques to acknowledge metropolitan sound grouping of ten classes. We have introduced a way to deal with sound grouping, which comprises of various highlights Firstly, we removed highlights from sound records in metropolitan sound 8K dataset and highlights. We have utilized four different ML organization models which are ANN, DT, RF and SVM. ANN outperformed all the other machine learning models and decision tree outperformed other models in particularly ML models.

Every one of the models have been prepared and tried with unique UrbanSound8K and its increased dataset voice signs of 10 distinct classes were perused by utilizing the python library called Librosa which utilizes two sorts of signs one is mono and other is sound system. Moreover, we might want to continue with this in our future work where we have intended to utilize novel solo learning procedures that can be embraced to prepare, test the models, and really look at their exactness.

### Future work and recommendations:

With the assistance of sound order, while giving suggestions or offering types of assistance, applications in cell phones would not just base on the spot data be able to yet in addition base on encompassing sound data. Consequently, applications can offer Figure 5 more precise support in view of general climate. Assuming a gadget can give a portrayal of general climate in view of the sound order to the impaired, it will assist them with keeping away from certain risks and make their life more helpful.

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